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Wild mushrooms in the hillside of Landour, Mussoorie

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***Abstract*—** *Landour is located at an altitude of about 6,800 to 7,798 ft in the Lower Western Himalaya, in the Mussoorie Range. Along the hillside of Landour one of the oldest residential schools in Asia, Woodstock School is situated. It encompasses a considerable forested area, which is mostly monoculture of Banj Oak (Quercus leucotrichophora) with intermittent Deodars, Pines and Rhododendrons. The climatic condition, forest type and soil in the hillside are congenial for growth and development of different species of mushrooms. A variety of mushrooms belong to edible, poisonous and medicinal species can be seen during rainy season. In the present study, six different mushroom species were collected during rainy season (July to September, 2022). Amongst the six species, five species were mycorrhizal, four species were edible, three species were medicinal and two species were non edible, while one species was poisonous. This study unravelled the abundance of the mushrooms in the campus.*

***Keywords*— mushroom, Landour, Uttarakhand.**

I. INTRODUCTION

Mushrooms are an important part of the ecosystem and over million species have been identified throughout the world till date. Fungi belonging to various taxonomic groups producing conspicuous sporocarps are collectively known as macro fungi which include “gilled fungi,” “jelly fungi,” “coral fungi,” “stink fungi,” “bracket fungi,” “puffballs,” “truffles,” and “birds nest” (Enow, 2013). Large fungi are those that form large fructifications visible without the help of the microscope and include Basidiomycota and Ascomycota with large observable spore bearing structures (Al thani, 2010). Macrofungal diversity is an important component of the global diversity, particularly community diversity, which is an essential part of fungal diversity (Li et al., 2012). According to Sarbhoy et al., (1996) the number of fungi species recorded in India were over 27,000. Bhatt et al., (2018) reported fifteen species of wild medicinal mushrooms belonging to 15 genera and 14 families in the Himalayas. Vishwakarma et al., (2011) reported 6 wild medicinal mushrooms in the Garhwal Himalayas. A survey of wild macro fungi associated with temperate evergreen forest of the Bharsar region of the Pauri Garhwal district, Uttarakhand, India, yielded specimens of 12 different species representing 10 genera (Semwal et al., 2014). Although extensive areas of the Uttarakhand state in the north western Himalaya of India are covered with forests, there have been relatively few taxonomic reports on the diversity of wild macro fungi (Bhatt et al., 1999, Bhatt et al., 2007a, Bhatt et al., 2007b, Chakraborty et al., 2017, Das and Sharma 2003, Das et al., 2016, Semwal et al., 2005, Semwal et al., 2006, Semwal et al., 2007) and many areas remain unexplored for their rich diversity of these organisms.

Landour is located in the Lower Western Himalaya, in the Mussoorie Range. It lies at an altitude of about 984 ft above Mussoorie, which itself is mostly at an altitude of 6,800 to 7,798 ft. Major part of Landour comprises of old forest growth consisting mainly of Deodar, Banj Oak, Chir Pine, Blue Pine, West Himalayan Fir, Himalayan Maple, Rhododendron, Himalayan Manna Ash and other tree species. A considerable area (330 acres appx.) of Landour, lies under the property of Woodstock School, Mussoorie, India. Major forest tree species in the campus comprise of Banj Oak (*Quercus leucotrichophora*, Deodar (*Cedrus deodara*), Rhododendron, Maple, Chir Pine. Due to restricted human interference, these forests are rich in biodiversity supporting various natural cycles. Besides supporting various life forms these forests support diverse varieties of mushrooms also. Mushrooms are used as both medicine and food, and are currently being studied for other uses like cleaning up oil spills and breaking down PCBs

(polychlorinated biphenyl, an organic environmental pollutant). Though a lot is known about how mushrooms can benefit humans, little attention is given to the importance of mushrooms to the forest. Although there are reports of various mushrooms from Mussoorie, meagre information is available on the diversity of mushrooms in the hillside of Landour, Mussoorie. The purpose of the paper is to begin the process of documenting the wild mushrooms in the area and further study their edibility, medicinal, ethnobotanical and cultural values This documentation can be used as a resource to cultivate new wild edible mushrooms to enhance the chances of improving the economy of the local villagers and to maintain the health of forests, since many wild mushroom are involved in the formation of ectomycorrhizal associations with the rootlets of the trees, with both partners in the relationship helping each other in many different ways (Semwal et al., 2014)

II. MATERIALS AND METHODS

Extensive nature walks alongside forest trails were undertaken between July and September 2022 in different localities of the Woodstock School campus in Landour, Mussoorie to collect the samples of macro fungi. During the field surveys, the macro fungi samples were collected with a great care to avoid damage to the base and other parts of the samples. Macroscopic details such as shape, size, colour, colour change on bruising or ageing, taste, odour, spore deposition of the fresh specimens (Largent 1977a, b) and ecological characteristics of the sample were recorded and samples were photographed in their natural habitats. Samples were kept in separate zip lock bags to avoid mixing and were taken to the laboratory. Macro and microscopic investigations were carried out on the samples. Collected specimens were dried, preserved in paper or polythene bags and accession numbers were given (Atri and Saini 2000). Identification of species was based on critical observations of the specimens and perusal of the relevant literature (Moller 1950, 1952, Moser 1978, Miller1981, Phillips 1991). The colour terminology used is that of the Methuen Handbook of Colour (Kornerup & Wanscher 1978). All the identified specimens were deposited in the science laboratory of Woodstock School, Landour.

Standard methods were followed for the collection, preservation, macro- and microscopic studies of the specimens (Singer 1986).

III. RESULT AND DISCUSSION

Some of the wild mushrooms along with their botanical name, family, description, collection place, habitat, collection date and various other details are being discussed as follows

Helvella crispa (Scop.) Fr.

Description

Pileus 15−50 mm broad, saddle-shaped, 2−3 regularly to irregularly lobed, white, creamy to slightly yellowish. Hymenium is the same colour as the pileus surface, hairy. Stipe 30−70 × 5−20 mm, tapering towards the pileus, with deep longitudinal furrows, ribs sharp-edged, irregular. Taste not recorded. Odour is indistinct. Spore deposit is not observed (Figure E).

Ecology - The mushroom was found under *Quercus leucotrichophora*, over moss covered soil, growing solitary or gregarious. It is also reported in both broadleaf and coniferous forests, and also occurs in open grassy or forested areas (Figure D).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie, Uttarakhand, India, 27 September 2022, WS/HC 01

Microscopic features – The asci comprises of 8 spores. Spores are ellipsoidal 16-21 x 10-14 µ; elliptical; smooth; with one large, central oil droplet and, sometimes, several smaller droplets at each end (Figure L).

Discussion – The white to buff cap and deeply ribbed or fluted stipe are characteristics of this beautiful elfin saddle. The fruiting bodies are edible when young but must be tried only after cooking them thoroughly. People recognize this mushroom by its saddle-shaped structure, white color and deep longitudinal furrows on the stipe. Previously reported by Singh et al., (2017) in Pauri, Uttarakhand.

Edibility – Edible, commented upon by Kaul et al. (1978), Purkayastha and Chandra (1985), Phillips (1991), Metzler et al., (1992). Atri & Lakhanpal (2002) and Singh et al., 2017.

Helvella lacunosa (Afzel.)

Description

Pileus: 10–40 mm across and 10–50 mm high; irregularly lobed and convoluted, or occasionally loosely saddle-shaped or cushion-shaped; black to very dark brown; bald but wrinkled; the margin usually attached to the stem in several places; under surface is grey to greyish brown. Stipe 10–40 mm long; 20–50 mm thick; greyish to dark grey; deeply and ornately ribbed and pocketed—the ribs rounded, or sometimes sharp and double-edged. Odour is not distinctive.

Ecology: These mushrooms are considered probably mycorrhizal; growing alone, scattered, or gregariously in woods under *Quercus leucotrichophora*. They are also reported to grow under conifers often in disturbed ground (Figure B).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie, Uttarakhand, India, 27 September 2022, WS/HL 02

Microscopic features: Spores 13–18 x 9–11 µm; broadly ellipsoid; smooth;. Asci is 200–250 x 10–15 µm; 8-spored, filiform, with rounded to clavate apices; smooth; hyaline to brownish, often with granular contents (Figure J and K).

Discussion- *Helvella lacunosa*, known as the slate grey saddle or fluted black elfin saddle in North America, simply as the elfin saddle in Britain, is an ascomycete fungus of the family Helvellaceae. The mushroom is readily identified by its irregularly shaped grey cap, fluted stem, and fuzzy undersurfaces. It is reported from Kashmir in India (Shameem et al., 2016) and in Sikkim (Das, 2010)

Edibility: This species is eaten and regarded highly by some after cooking, though the stems are not eaten. Lightfoot regarded it as edible in 1777, although this genus is now regarded with suspicion due to the presence of toxic compounds in several related species. It has been reported to cause gastrointestinal symptoms when eaten raw (Ammirati et al., 1985) as it may contain small amounts of the toxin monomethylhydrazine. Therefore, cooking is required before consuming (Davis, 2012)

Ganoderma sp.

Description

Pileus 3-23 cm broad, kidney shaped, elongated, more or less fan shaped at maturity, red to reddish brown when mature, when young often with zones of bright yellow and white toward the margin (Figure H). Tubes up to 2 cm deep. Pores 0.1 cm, whitish, usually bruising brown. Stipe 3-12 cm long and 1-2 cm thick, twisted, cylindrical, smooth, dark red to black with a varnished crust.

Ecology: Solitary to scattered sometimes gregarious, on living hardwoods for eg. *Quercus leucotrichophora*, usually near the base of the tree. The mushroom was found growing on the roots of Banj Oak tree (Figure G).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie, Uttarakhand, India, 27 September 2022, WS/GND 03

Microscopic features: Spores 9-12×5.5-8 µ; more or less elliptical.

Discussion: *Ganoderma* sp. is the most popular medicinal mushroom of the world. It has been used for a wide range of health benefits from preventive measures and maintenance of health to the management and treatment of chronic as well as acute human aliments (Rai 1997). *Ganoderma* sp. is previously reported from different parts of Uttarakhand. Species of Ganoderma are known to cause different kinds of rots in both angiosperms and gymnosperms by lignocellulose degradation. *Ganoderma* sp. is a common root pathogen that causes the decay and slow decline of numerous forest tree species (Bakshi,1976; Ko, 2009).

Edibility: It is edible and tastes slightly bitter. Ganoderma tea is relished in different parts of the world. It is also eaten in different parts of Uttarakhand.

Strobilomyces strobilaceus

Description

The cap of the fruiting body is about 6-12 cm in diameter. With age the convex cap becomes flatter and firmer and is covered with dark grey to black pyramid type protrusions. The flesh is white and then slowly dark grey or black. Stipe is up to 10 to 15cm tall. Mostly found between August to October. The odour is slightly earthy.

Ecology: The mushroom was found growing under *Quercus leucotrichophora* and Pine forest in Woodstock School, Mussoorie. It often grows alone and because it is mycorrhizal, hence, it will not be found growing on dead or decaying material (Figure F).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie, Uttarakhand, India, 30 September 2022, WS/SS 04

Microscopic features: The elliptical, dark brown to black spores measure 9-15 × 8-12 microns and are covered with a net-like pattern.

Discussion: Commonly known as Old Man of the Woods, this is one of many mycorrhizal fungus species that help nourish forest trees through symbiosis. The netlike fibres of the fungus cover the surface of a tree's roots, increasing the surface area and the root's ability to absorb water and nutrients. In return, the tree shares nutrients with the fungus. Old Man of the Woods blends in with the background landscape of the woods and forests and can be sometimes challenging to find. As it ages, it becomes darker and resembles a pine cone rather than the mushroom and is quite resistant to decay, unlike other fungi in the Boletaceae family.

Edibility: This distinctive bolete is generally considered edible but of very limited culinary value.

Scleroderma sp.

Description

The fruiting body is 20-120 mm in diameter; roughly spherical in shape; the surface hard and scaly, yellowish to

yellow-brown, often cracked. As the fungus matures, it can turn ochre-brown. Stipe have a few root-like mycelial threads which are attached to the soil. Spores: the spore mass is greyish, becoming purply-black. The individual spores are spherical and spiked. When mature, the outer skin ruptures, creating a large, irregular opening which releases the spores which are then dispersed by wind and rain

Ecology- The species is mycorrhizal with hardwoods and conifers. It is often found in mossy areas beneath *Quercus leucotrichophora*. It grows alone, scattered, or gregariously and widely distributed (Figure C).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie Uttarakhand, India, 27 September 2022, WS/Scl 05

Microscopic features: Spores are 8-13 µm and round in shaped, prominently reticulate (Kuo, 2004)

Discussion: Commonly known as Earth Ball mushroom, *Scleroderma* sp. is a mycorrhizal fungus similar in appearance to a warty potato. It prefers acid soils and mossy or peaty ground on heaths and in woodland, especially on sandy soil. One can observe them on compacted paths in woods and forests.

Edibility- *Scleroderma* sp. has been identified as poisonous and spore inhalation by humans has been reported to cause various symptoms including gastrointestinal distress, rhinitis, tachycardia, unconsciousness, dyspnea, and lacrimation (Uroz et al., 2006).

Humaria hemisphaerica

Description

They are goblet shaped when young, and gradually become cup-shaped and reaching widths of 2-3 cm when mature, fairly smooth; under surface densely hairy with prominent hairs that extend above the margin of the cup, brown; odour none; flesh brownish or pale, brittle. This species typically does not have a stipe although there is small abrupt base sometimes. This mycorrhizal fungus is recognized by its white inner surface and hairy brown outer surface.

Ecology: *Humaria hemisphaerica* grows solitary, scattered, or in groups on the ground or sometimes on rotten wood in wooded areas. It was found growing in clusters in the rhizosphere of Deodar tree (Figure A).

Specimen examined – The sample was collected from Woodstock School, Landour, Mussoorie, Uttarakhand, India, 27 September 2022, WS/HH 06

Microscopic features: Spores 20-24 x 10-12 µ; elliptical, often with somewhat flattened ends; Asci eight-spored (Kuo, 2012)

Discussion: It is commonly known as the hairy fairy cup (Arora, 1986) is a species of fungi in the family Pyronemataceae. This mycorrhizal fungus is recognized by its white inner surface and hairy brown outer surface. Previously it was reported by Thind and Sethi (1957) on dead twigs and soil under Cedrus forest in Mussoorie.

Edibility: Inedible

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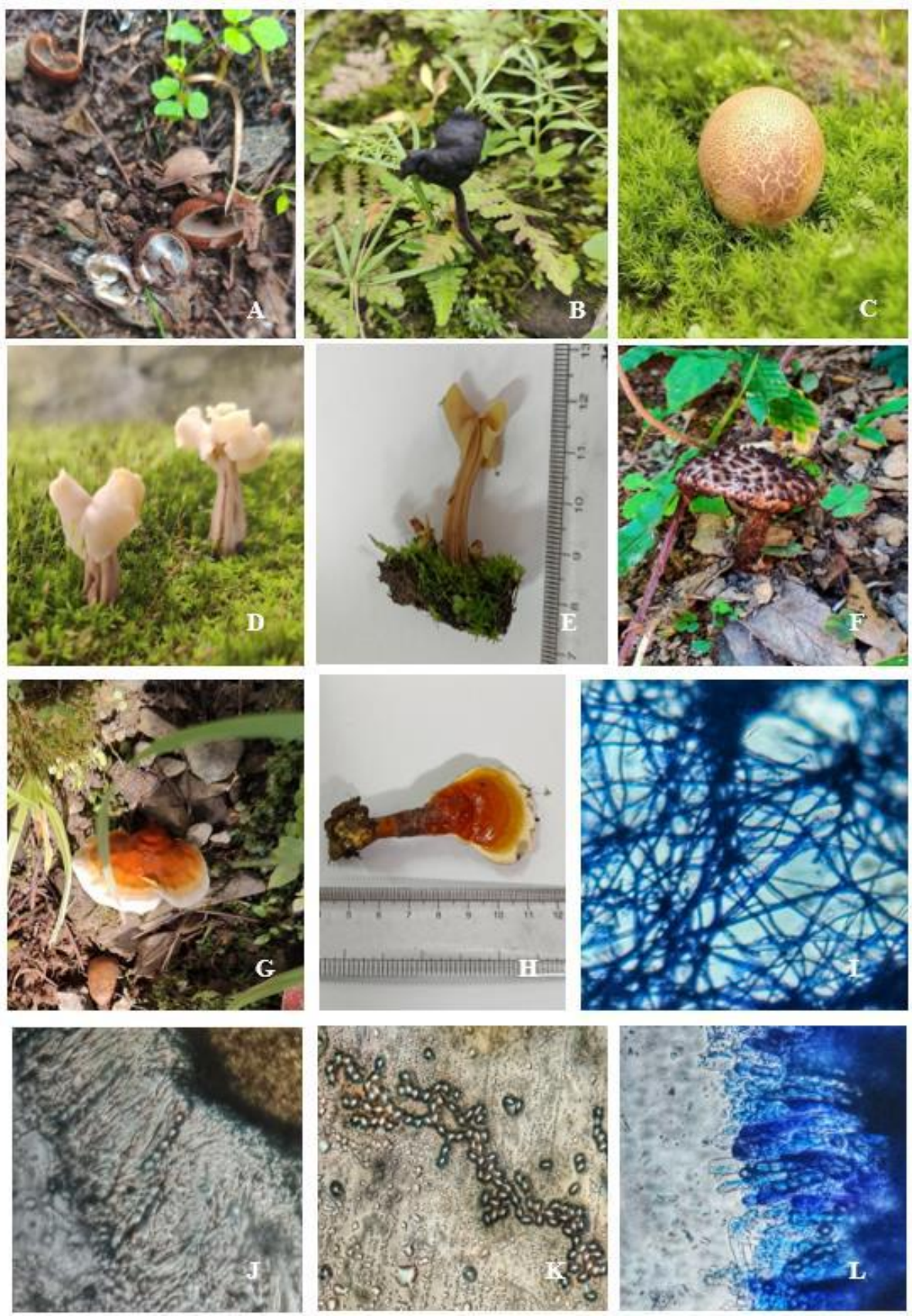

A. *Humaria hemisphaerica* B. *Helvella lacunosa C. Scleroderma* sp. D. *Helvella crispa* E. Morphological study of H. *crispa* F. *Strobilomyces strobilaceus* (Old man of the woods) G. Ganoderma sp. H. Morphological study of *Ganoderma* sp. I. Mycelial network of *Ganoderma* sp. J & K. Asci and spores of *H. lacunosa* under microscope L. Asci and spores of *H. crispa* under microscope

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